Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive
Pasadena, California 91109-8099
(818) 354-4321

March 24, 1998
Refer to: 621-EHK:LightSAR

TO WHOM IT MAY CONCERN

Subject: LightSAR Program Payload Technology Alliance Membership

Enclosure: Request For Proposal No. L04-1-2629-975

The Jet Propulsion Laboratory /California Institute of Technology (JPL/CIT), operating under a contract with the National Aeronautics and Space Administration (NASA), is soliciting proposals for LightSAR Program Payload Technology Alliance Membership. The Request for Proposal (RFP) is enclosed.

LightSAR is a new program which will utilize advanced technologies to reduce cost and enhance the quality of the radar-based information for scientific research, commercial remote sensing, and emergency management applications. NASA and industry will share technical and financial risks associated with technology advancement and product development. NASA's Jet Propulsion Laboratory (JPL) will provide overall program management and lead the development of the L-band radar instrument, with industry providing the spacecraft, the ground segment and the mission operations activities. Industry has the option of adding enhanced capabilities to meet their commercial objectives, such as an additional radar band with higher resolution.

Following an initial short, on-orbit validation phase of a few months, it is intended that the LightSAR mission, including instrument, spacecraft and ground segment be handed over to a commercial consortium. The opportunity to participate in this commercial aspect and Operational Phase of the LightSAR mission will be announced separately.

This solicitation focuses on technologies suitable for the L-Band synthetic aperture radar (SAR). The LightSAR program anticipates forming a Payload Technology Alliance of initially 10 to 20 members. The team will work together in a coordinated and cooperative manner applying their combined expertise, technology and resources to fulfill program objectives. Members are sought who are leaders in breakthrough technologies that will reduce the cost and enhance the capabilities of the LightSAR radar instrument. Design study phase team members are anticipated to be a primary, but not exclusive, source of new technologies for flight validation. However, selection for membership on the LightSAR instrument Payload Technology Alliance (PTA) does not guarantee that the member's proposed technology will be selected for the final flight instrument.

JPL/NASA seeks to encourage proposals for new members to join the Payload Technology Alliance for the design study phase of the LightSAR program. There will be three phases in the development of the L-Band payload for LightSAR. The first, the design study phase, will last six months and is the subject of this solicitation. The second, the design validation phase, will follow on from the design study phase, and will last 6-12 months. A flight hardware development phase will follow for the final technologies down-selected from the candidates, with duration to be determined.

Selection for membership of the Payload Technology Alliance for the candidate technology design study phase does not guarantee that the member's proposed technology will be selected for follow-on phases, including for the final flight instrument. JPL/NASA reserves the right to add members to the alliance at a later date.

As a convenience to JPL, you are requested to provide the undersigned by no later than April 3, 1998, a FAX statement that you do or do not intend to submit a proposal.

This RFP does not constitute a commitment, implied or otherwise, that JPL will take procurement action in this particular matter. JPL, or the Government, will not be responsible for any costs incurred by your organization in preparing a proposal to this RFP.

Sincerely,

Original Signed By: E. H. Kieckhefer

E.H. Kieckhefer
Member Acquisition Staff
(818) 354-1293
Fax: (818) 354-3494

Enclosure: RFP No. L04-1-2629-975

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY

REQUEST FOR PROPOSAL

REQUEST FOR PROPOSAL NO. L04-1-2629-975

FOR

LIGHTSAR PROGRAM PAYLOAD TECHNOLOGY ALLIANCE MEMBERSHIP

PROPOSALS TO BE RECEIVED AT JPL NO LATER THAN

Date: April 15, 1998

Local Time: 3:00 P.M.

COMMUNICATIONS IN REFERENCE TO THIS RFP

It is requested that any communication in reference to this RFP be in writing and directed to the attention of:

Name: E. H. Kieckhefer Mail Station: 190-220
(818) 354-1293
Fax: (818) 354-3494

Title: Member Acquisition Staff

California Institute of Technology
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA 91109-8099

Date of Issuance: March 25, 1998

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GENERAL INSTRUCTIONS

1. PROPOSAL REQUIREMENT

The effort to be performed, delivery schedule and/or performance period, and contract type will be in accordance with the Specimen Contract, dated: 3/24/98: **If you choose to submit more than one proposal for this effort, each proposal must be independently complete and under separate cover.**

2. PACKAGING AND SUBMITTING YOUR PROPOSAL

(a) Organization and Format.

(1) Your proposal, which should be organized as closely as practicable to the format and sequence indicated in these proposal instructions, must be submitted as outlined below. Please note that JPL has assigned a mandatory page limitation to the individual proposal volumes. Technical, management and cost information MUST be submitted within its respective volume. Any information not pertaining to a particular volume will be excluded from evaluation (e.g. management information included in the cost volume will not be evaluated etc.)

Volume No./Title	Page Limit	Number of Copies
I Technical/Management/Past Performance Section A - Technical Approach Section B - Management and Cost Plan Section C - Past Performance	10 pages	10
II. Cost Volume	No Limitation	3

(2) For the purpose of the mandatory page limitation, the following rules apply:

A. All text must be typed on 8 1/2" x 11" paper.
B. Drawings will be considered as part of the page count. Fold out drawings will be counted proportionally as additional pages (e.g. 11" x 17" will be counted as two pages, etc.).
C. A minimum of single spacing is required. Page margins shall be no less than 1/2" inch at the top, bottom, and sides.
D. Type font size shall be no smaller than 12-point Times Roman font, with single spacing.
E. A page is defined as each face of a piece of paper containing substantive evaluatable information. Any pages which exceed the above noted limitations will be removed from the proposal and will not be evaluated.

(3) Unnecessarily elaborate brochures or presentation layouts, other than those sufficient to present a complete and effective proposal, are not desired. Except when specifically requested, mockups, models, samples, hardware, or software of any kind must not be furnished and will not be considered.

(4) JPL reserves the right to retain all proposal information submitted in response to this RFP.

b. Address and Identification.

To help ensure timely receipt and processing of your proposal, please affix the enclosed yellow adhesive label to the envelope/container containing the complete original copy of your proposal. (NOTE: The yellow label is JPL's notification that the package you send is a proposal.) In case the mailing label is lost, address your proposal on a similar yellow label containing JPL's address,

the name of the individual designated on the cover page of this RFP (including the mail stop) and the RFP number. All proposal envelopes/containers must be identified with the RFP number that appears on the RFP cover page.

c. Hand Carried Proposals.

Hand-carried proposals must be delivered to the California Institute of Technology/Jet Propulsion Laboratory (JPL) Visitor Control Center, at 4800 Oak Grove Drive, Pasadena, Building 249, where it will be received and time-stamped. Visitor Control is open to receive proposals only on working weekdays, between 7:30 a.m. and 4:30 p.m. (proposals are due at the time and date stated on the cover of this RFP).

3. GENERAL INFORMATION

a. Pre-Award Costs.

This RFP does not commit JPL or the Government of the United States (the Government) to pay any costs incurred:

(1) In submitting the proposal;
(2) In making any studies or designs for preparing the proposal;
(3) In procuring or subcontracting for services or supplies related to submitting the proposal; or

b. JPL's Proposal Acceptance and Negotiation Rights.

JPL reserves the right to accept or reject any or all proposals and to negotiate with any source that JPL considers to be in its best interest.

c. Retention of RFP and Proposal Material.

(1) Except where specified otherwise, the material furnished with this RFP should not be returned to JPL.
(2) JPL reserves the right to retain all proposal information submitted in response to this RFP.

d. Data.
If the proposal contains data that either you or your subcontractors do not wish to be disclosed for any purpose other than proposal evaluation, you must mark the cover sheet of each volume containing such information with the legend below:

"Data contained in pages _____ of this proposal furnished in connection with RFP No. L04-1-2629-975 shall not be used or disclosed, except for evaluation purposes, provided that if a contract is awarded to this offeror as a result of or in connection with the submission of this proposal, JPL and the Government shall have the right to use or disclose this data to the extent provided in the contract. This restriction does not limit JPL's right to use or disclose any data obtained from another source without restriction."

e. Requests for Clarification/RFP Addenda.

During the proposal preparation period, all requests for clarification and/or additional information, must be submitted in writing to the individual referenced by "Attention:" on the cover page of this RFP. When appropriate, responses to requests, as well as any JPL initiated changes, will be provided to all prospective proposers in writing as addenda to the RFP. (NOTE: You must include reference to all addenda on your Acknowledgment to this RFP [Attachment A-1].)

4. LATE PROPOSALS

Any proposal, portion of a proposal, or unrequested proposal revision received at JPL after the time and date specified on the cover page of this RFP is late. Any volume of a proposal received after the time and date specified will cause the entire proposal to be late. Late proposals will not be considered for award, except under the following circumstances:

a. JPL determines that the late receipt was due solely to a delay by the U.S. postal service for which the offeror was not responsible. Timely postmark or receipt of registered or certified mail establishing the time of deposit must be evidenced.

b. JPL determines that the proposal was late due solely to mishandling by JPL after receipt at JPL, provided that the timely receipt at JPL is evidenced.

c. No acceptable proposals are received in a timely manner.

NOTE: If an emergency or unanticipated event interrupts normal JPL processes so that solicitation responses cannot be received to the JPL office designated for receipt by the exact time specified in the solicitation, and urgent JPL requirements preclude amendment of the solicitation closing date, the time specified for receipt of proposals will be extended to the same time of day specified in the solicitation on the first work day on which normal JPL processes resume.

d. RFP Addenda.

(1) During the proposal preparation period, requests to clarify certain aspects of the RFP package or for additional information must be in writing and sent to the individual designated on the RFP cover page.

(2) JPL responses providing additional information or clarification will be provided to all prospective proposers in writing as addenda to the RFP. In addition, any JPL-initiated changes to the governing documents in the RFP package will be provided to all prospective proposers as addenda to the RFP. JPL will not be responsible for explanations or interpretations of the RFP by any other means. (NOTE: You must include acknowledgment to all addenda on your Acknowledgment to this RFP [Attachment A-1].

e. Proposal Revisions and Supplements.

(1) JPL's policy is not to consider proposal revisions or supplementary proposal information received after the time and date specified on the RFP cover page, unless such proposal revisions or supplements have been specifically requested by JPL, and then only to the extent specified. In conducting the evaluation process, JPL may request written supplementary information during discussions to confirm subjects discussed; however, such supplementary information must be limited to that specified by JPL.

(2) Since there may be no opportunity for proposers to voluntarily initiate proposal revisions or to furnish supplementary information, your proposal should be submitted initially with the most favorable terms possible.

(3) After contractor(s) selection, JPL reserves the right to consider and accept or reject proposals submitted at any time by the contractor(s) selected for negotiation.

5. SOURCE EVALUATION AND SELECTION PROCESS

a. Source Evaluation.

Proposals will be evaluated in the areas of technical and management as described in paragraph 6 below. Although cost will not be scored, cost is a substantial factor and is of approximately equal importance to the combined technical and management areas. JPL plans to make source selection based on the offeror whose proposal is determined to represent the best value to JPL. JPL's best value source selection is based on the following: If all offers, in the competitive range, are of approximately equal qualitative (technical and management) merit, JPL will select for negotiations the offer with the lowest cost. However JPL may select for negotiations a contractor whose proposal offers a higher qualitative merit if the difference in cost is commensurate with added value. Conversely, JPL may select for negotiations a contractor whose proposal offers a lower qualitative merit if the cost differential between it and other offers so warrants. For purposes of this evaluation, JPL may use the proposed costs or the JPL-determined probable costs, as defined in paragraph (a)(6) below. JPL will evaluate the proposals utilizing the following process:

(1) Before issuing the RFP, JPL establishes specific criteria and their weighting for the evaluation of the Technical and Management proposals. After receipt at JPL, the proposals are evaluated against the pre-set criteria outlined in paragraph 6 below.

(2) An analysis of the supporting cost details is performed and the proposed costs are compared. If the Buy American Act, the Balance of Payments Program, or rent-free use of Government-furnished property applies, costs will be adjusted as required for the purpose of evaluation.

(3) Responsibility is assessed within the meaning of Federal Acquisition Regulation 9.1. Award will not be made to a Contractor deemed to be nonresponsible.

(4) A. Results of the initial proposal evaluation are used to determine which proposals are within the competitive range (i.e., those having a reasonable chance of being selected for award). Proposals determined not to be within the competitive range are eliminated from further consideration, and the proposers are notified accordingly.

B. JPL may, at its discretion, conduct limited communications with one or more contractors for the purpose of determining whether the proposer should be included in the competitive range. Such precompetitive range communications shall be limited to the following areas:

i. Validating the proposed price; and
ii. Clarifying omissions, ambiguities and uncertainties in the proposer's supplemental business/cost information and past performance.

C. JPL reserves the right to make a competitive range determination without conducting such communications.

(5) JPL may make source selection after the initial proposal evaluation or may conduct discussions with the proposers determined to be within the competitive range. The purpose of the discussions is to assist the evaluators in fully understanding each proposal by:

A. Clarifying those aspects of each proposal which contain omissions, ambiguities and uncertainties;

B. Verifying and identifying strengths and weaknesses which could affect work performance;

C. Verifying the validity of the proposed cost; and

D. Assessing the proposed personnel and the proposer's capabilities for performing the work.

(6) A. After discussions, the initial evaluation findings are reviewed and may be revised to incorporate the results of the discussions to arrive at a final evaluation. This final evaluation includes completing a thorough assessment of the cost realism of each proposed cost estimate and comparing the cost estimates. In performing this assessment, JPL may develop a "probable cost" for each proposer. "Probable cost" is defined as JPL's best estimate of the cost of any contract that is most likely to result from the offeror's proposal. (NOTE: JPL will not request best and final offers (BAFOs).)

B. Selection Process.

The results of the final evaluation are submitted to the JPL Source Selection Official, who selects the Contractor(s) for negotiation.

C. JPL reserves the right to reject all proposals, to award a contract based on initial proposals (without proposal clarifications) or conduct oral discussions (for the purpose of proposal clarification) prior to making source selection.

6. TECHNICAL AND MANAGEMENT EVALUATION CRITERIA

a. The successful evaluation of the proposed technology and its applicability to the objectives of the LightSAR mission is the method used to screen potential members. The following criteria will be used to evaluate all viable responses:

(1) Applicability to LightSAR Objectives: Degree to which the proposed technology enables achievement of LightSAR objectives. Factors to be considered are:

A. High-value technology in terms of performance (e.g. mass, power) for key elements of the LightSAR instrument.

B. Potential to reduce the cost of the LightSAR mission.

(2) Maturity and Cost of Technology: Degree to which the proposed technology has been developed and its likelihood of readiness for integration and operation for a year 2001 launch, or high pay-off technologies that are at a lower level of maturity, but can be reliably made ready for launch in 2002, and the proposed technology(s) can operate reliably over a 5-year mission. Factors to be considered include:

A. Current status of the technology development effort and degree to which the technology has been demonstrated.

B. Methodology planned or implemented to demonstrate the feasibility and flight readiness of the proposed technology, including schedule and cost for development and test of a prototype unit, including proposed cost sharing.

C. Schedule and rough order-of-magnitude costs for the development and delivery of an operational flight unit, including proposed cost sharing, for a LightSAR year 2001 flight.

D. Approach to developing an accurate cost estimate, and plan for control of cost, schedule and technology performance for development and delivery of operational flight unit(s) for a LightSAR year 2001 launch.

(3) Capabilities: Degree to which the proposer is capable of providing proposed technologies to the LightSAR program. Factors to be considered are:

A. Historical performance in the area of SAR technology development, flight system insertion, and subsequent application.

B. Commitment of the organizational management to the proposed technology delivery (evidenced by cost and resource sharing, prior teaming arrangements, etc.).

C. Availability/readiness of key personnel and facilities and the particular expertise of the proposed member.

Criterion 1 is weighted at 40% of total technical/management score and criteria 2 & 3 are weighted at 30% each.

(b) Other factors to be considered will include but not be limited to:

(1) Financial Capability

7. EXCEPTIONS

A large number of exceptions or one or more significant exceptions to the General Provisions and/or Additional General Provisions may make your proposal unacceptable for evaluation. You must provide a detailed explanation, including the rationale, for any exception you take. Proposers who submit proposals with exceptions may be selected for negotiations. However, if an agreement cannot be negotiated, your proposal may be rejected.

PROPOSAL INSTRUCTIONS

INTRODUCTION

LightSAR is a new program which will utilize advanced technologies to reduce cost and enhance the quality of the radar-based information for scientific research, commercial remote sensing, and emergency management applications. NASA and industry will share technical and financial risks associated with technology advancement and product development. NASA's Jet Propulsion Laboratory (JPL) will provide overall program management and lead the development of the L-band radar instrument, with industry providing the spacecraft, the ground segment and the mission operations activities. Industry has the option of adding enhanced capabilities to meet their commercial objectives, such as an additional radar band with higher resolution.

Following an initial short, on-orbit validation phase of a few months, it is intended that the LightSAR mission, including instrument, spacecraft and ground segment be handed over to a commercial consortium. The opportunity to participate in this commercial aspect and Operational Phase of the LightSAR mission will be announced separately.

This solicitation focuses on technologies suitable for the L-Band synthetic aperture radar (SAR). The LightSAR program anticipates forming a Payload Technology Alliance of initially 10 to 20 members. The team will work together in a coordinated and cooperative manner applying their combined expertise, technology and resources to fulfill program objectives. Members are sought who are leaders in breakthrough technologies that will reduce the cost and enhance the capabilities of the LightSAR radar instrument. Design study phase team members are anticipated to be a primary, but not exclusive, source of new technologies for flight validation. However, selection for membership on the LightSAR instrument Payload Technology Alliance (PTA) does not guarantee that the member's proposed technology will be selected for the final flight instrument.

JPL/NASA seeks to encourage proposals for new members to join the Payload Technology Alliance for the design study phase of the LightSAR program. There will be three phases in the development of the L-Band payload for LightSAR. The first, the design study phase, will last six months and is the subject of this solicitation. The second, the design validation phase, will follow on from the design study phase, and will last 6-12 months. A flight hardware development phase will follow for the final technologies down-selected from the candidates, with duration to be determined. Selection for membership of the Payload Technology Alliance for the candidate technology design study phase does not guarantee that the member's proposed technology will be selected for follow-on phases, including for the final flight instrument. JPL/NASA reserves the right to add members to the alliance at a later date.

The LightSAR radar Payload Technology Alliance will focus on technologies suitable for a low-cost, lightweight, high-performance L-band SAR which are at a sufficient level of maturity to be ready for a launch in the year 2001. High pay-off technologies that are at a lower level of maturity, but can be reliably made ready for launch in 2002 may also be considered. Key technologies which will be provided by the Payload Technology Alliance members include:

(a) Efficient, lightweight, transmit/receive (T/R) modules for an L-Band phased array
(b) Lightweight, robust, planar array deployment/support structures
(c) Lightweight, phased array antenna design, development and test
(d) Any other suitable technologies which can reduce the mass and cost and/or enhance the performance of the LightSAR payload

For the initial design study phase, JPL expects to award contracts in each of these key technology areas, described above, as follows:

(a) T/R modules: anticipate two or more design studies, contract not to exceed $200,000 each;
(b) Planar array deployment/ support structures: anticipate two or more design studies, contract value not to exceed $75,000 each;
(c) Lightweight, phased array antenna: up to two design studies, contract value not to exceed $75,000 each; and
(d) Any other suitable technologies which can reduce the mass and cost and/or enhance the performance of the LightSAR payload: up to four design studies, contract value not to exceed $25,000 each.

NOTE: If you choose to submit more than one proposal for this effort, each proposal must be independently complete and under separate cover.

PROPOSAL PREPARATION

This portion of the Proposal Instructions sets forth the requirements to be followed in the preparation the proposal. The proposal should be no more than 10 pages long, and typed in a 12-point Times Roman font, with single spacing. The proposal should consits of three sections. The following information shall be provided in each section to permit an evaluation of your qualifications and the effectiveness of the methods proposed to perform the effort required by the Specimen Contract.

Section I - Technical Approach

Proposals should address how new technology can be utilized to solve the problem of reducing the mass, volume and power consumption of key components of a high-performance imaging radar such as the LightSAR radar instrument. Proposals are encouraged which employ innovative approaches to the design of such a radar instrument to be deployed on a free-flying spacecraft platform. Proposers are also asked to address the issue of whether their proposed approach is sufficiently mature for a launch in the year 2001 and for reliable operation over a five-year mission. Proposers should provide their plan for the process to be used from concept formulation to final delivery of the flight hardware.

Section II - Management and Cost Plan

The proposed management structure for the activity should be presented in the proposal, including the assignment of key personnel, and the percentage of their time available for the proposed activity. Proposals should also include a detailed schedule and cost breakdown that covers the Design Study Phase activity, which should include: (1) a short period to define the proposed technology; (2) an additional period for the design of a key element of the LightSAR radar instrument; and (3) separate follow-on plans, indicating costs and schedules, for the design validation phase and flight hardware development phase for their proposed technology. Any cost or resource sharing should be identified in this section of the proposal.

Section III - Past Performance

The proposal should address the degree to which the proposing team has executed the successful development of similar technologies in the past. Describe past or continuing activities within the proposing team which are related to the proposed effort, and then document the experience of team members in the area of technology proposed. Only those patents, reports and publications by the team members which are relevant to the proposal should be listed.

Discuss three programs of similar technical complexity within the last five years, or currently in process, that illustrate previous related similar experience to the effort being proposed; include in your discussion the following:

(1) For each program mentioned, identify the Sponsor and Contract number; Customer name and current address; Current cognizant contract negotiator and technical person; and Current telephone numbers; Period of performance; Contract type; Average number of personnel on the contract; and the initial and final/current cost or price, as well as any overrun and explanation of such overrun that may have been incurred.

(2) For each program mentioned, identify similarities and differences between the items described and the proposed effort, and identify whether the program was completed on baseline schedule. Discuss controls implemented to manage costs.

(3) One of the three programs is to be a worst-case experience. Describe the problems encountered and the lessons learned, indicating what is being done on current programs, or would be done differently on the program to mitigate or prevent a recurrence.

(4) Discuss how baseline cost and schedule was controlled on each program. Provide your past performance with respect to cost and schedule.

PROPOSAL INSTRUCTIONS - COST

VOLUME II

(For Cost-Reimbursement Proposals)

1. INTRODUCTION

   a. Below are the requirements for preparing your cost proposal, supporting data, and supplemental business/cost information.

   b. Computer print-outs instead of the various cost proposal forms indicated below are acceptable for submittal.

2. COST PROPOSAL

   Cost Breakdown. Provide a cost breakdown of total estimated costs for the proposed effort, itemized by cost elements, on form JPL 0549-1, "Cost Elements Breakdown" (see "Attachments to the Solicitation," form JPL 2839), or in a similar format.

3. COST ELEMENTS SUPPORTING DATA

   The following information is required in support of your estimated cost.

   a. Direct Labor.

      (1) Explain the basis of the labor-hour estimates by classification. Show all calculations in detail including the development of any factored hours and the base to which the factor is applied.

      (2) Discuss the development of the labor rates including all escalation factors. Include a summary rate table by classification and lowest fiscal distribution (i.e., by quarter if rates change quarterly). If available, submit evidence of Government approval of direct labor rates for each labor classification.

   b. Material.

      Submit a breakdown of raw materials and purchased parts including: basis of estimates, part number, description, quantity, unit price, extended price, and source of supply. Describe any pricing factors proposed such as scrap, rework, and usage.

   c. Subcontracts.

      Identify each effort to be subcontracted. List the selected subcontractor’s name, location, amount proposed and type of contract. Explain any adjustment made to the subcontractor’s proposed costs. Describe the cost or price estimates for each subcontract.

d. Other Direct Costs.

(1) Travel and Relocation.

(a) Indicate the destination, duration and purpose of each trip proposed. Detail the development of each cost element included in the per trip cost.

(b) Submit current company policy regarding the reimbursement of travel relocation costs and the accounting of such costs as a direct or indirect expense.

(2) Special Tooling and Special Test Equipment.

(a) Special Tooling and Special Test Equipment are defined in the JPL form entitled "Management of Government Property in the Possession of Contractors," which is incorporated into the Specimen Contract. Describe each item of Special Tooling and Special Test Equipment you proposed; explain how it meets the definition referenced above; indicate where and when each item is to be used and the extent of usage.

(b) Explain the Basis of Estimate and furnish supporting data for each item of Special Tooling and Special Test Equipment in accordance with the requirements of the paragraphs entitled "Direct Labor," "Material" and "Subcontracts" above.

(3) Computer Usage.

Describe the proposed computer usage, extent of usage, rate(s), and the total cost. Explain the development of the rate(s).

(4) Consultants.

Indicate the specific task requiring consultant services. Identify the proposed consultants, state the proposed hourly/daily rate, the estimated number of hours/days, and any associated costs (such as travel). State whether the consultant has been compensated at the quoted rate for similar services performed in connection with Government contracts.

(5) Licensing and Royalty Information.
If your proposal contains costs for royalties or licenses, indicate the amount and be ready to furnish details.

(6) Other.
Explain and support any additional other direct costs included in the proposal.

e. Indirect Costs.

(1) Discuss the development of each proposed indirect expense rate (e.g., labor overhead, material overhead, off-site burden, general and administrative (G&A)). Specifically identify the cost elements included in the base to which each rate is applied. List the indirect expense rates experienced for the past two years. Explain any significant variance between the experienced and proposed rates. Submit evidence of Government approval of each indirect rate if available.

(2) Identify separately any independent research and development expenses included in the G&A rate.

4. SUPPLEMENTAL BUSINESS/COST INFORMATION

a. Financial Statement

Submit a copy of your annual financial statements for the last three years and any information regarding additional resources required to perform the proposed effort such as an established line of credit or other financial resource. If this information has recently been submitted to JPL resubmittal is not necessary, simply reference the applicable JPL RFP number under which the data was submitted.

b. Attachments

The Section of this RFP entitled "Attachments" consists of those forms and documents containing information applicable to this RFP. Group A Attachments must be completed and attached to your cost proposal. Group B Attachments consist of forms and documents for informational purposes only and can be accessed via the electronic address provided below. Hard copies of the Group B Attachments will be mailed by request only. Note that the Group B Attachments are very important and may be required under the Contract and are available on the World Wide Web.

World Wide Web: http://acquisition.jpl.nasa.gov/

ATTACHMENTS TO THE SOLICITATION

The following attached forms and documents are organized into two major groupings:

1. Group A must be completed and returned as part of your quotation or cost proposal.

2. Group B are for information purposes only in preparing your quotation/proposal.

NOTE TO PROPOSERS: *Forms and documents listed below are not applicable unless the box preceding the Attachment Number is marked* ☒.

GROUP A - Complete and return as part of your quotation/cost proposal, as applicable:

	Attachment Number	Title and Form Number
X	A-1	Acknowledgment (form JPL 2384)
	A-2	Cost Accounting Standards (form JPL 2842)
X	A-3	Government Property Questionnaire (form JPL 0544)
	A-4	(RESERVED)
	A-5	(RESERVED)
	A-6	Notice of Total Small Business Set-Aside (form JPL 4022)
	A-7	Notice of Total Small Business Set-Aside - Modified (form JPL 4023)
	A-8	(RESERVED)
	A-9	(RESERVED)
	A-10	(RESERVED)
	A-11	(RESERVED)
	A-12	Foreign Acquisitions - Certification of Eligibility for Exemption from/Certain JPL General Provisions, Additional General Provisions, and Certifications (form JPL 2881)
	A-13	Certification of Implementation/Administration of Applicable Occupational Safety and Health Programs (form JPL 2885)
	A-14	Past Performance (form JPL 0358)
	A-15	Cost Element Breakdown (form JPL 0549)
	A-16	Determination of Lowest Overall Price - Time-and-Material Proposals (form JPL 0359)
	A-17	Determination of Lowest Overall Price - Labor Hour Proposals (form JPL 0363)
	A-18	Determination of Lowest Overall Price - Labor-Hour Proposals to JPL-Provided Rate Ranges (form JPL 0364)
X	A-19	Cost Elements Breakdown (Short Form) (form JPL 0549-1)

GROUP B - For information only:

Attachment Number	Title and Form Number
☐ B-1	Waiver of Rights to Inventions (form JPL 62-301)
☐ B-2	Summary Work Breakdown Structure (no form number)
☐ B-3	Notice to Offerors (form JPL 2843)
☐ B-4	° Instructions for Patent Agreement for Use in Support Service Contracts (form JPL 2844) ° Patent Agreement (form JPL 1929)
☐ B-5	Notice of Requirement of Pre-award On Site Equal Opportunity Compliance Review (form JPL 3553)
☐ B-6	Requirements for A Subcontracting Plan (form JPL 0294)
☐ B-7	Security Requirements for a Classified Contract (form JPL 2891)
☐ B-8	Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246) (form JPL 2899)
☐ B-9	Notice to Prospective Contractors of Requirement for an Environmental Audit of the Lease Facilities (form JPL 2896)
☐ B-10	Certificate of Current Cost or Pricing Data (form JPL 2496)
☐ B-11	Standards of Conduct and Procedures for Handling Contractor Personnel Problems, Discipline, and Separation (form JPL 4412)
☐ B-12	° Electronic Funds Transfer (EFT) Invoice Payment Service (form JPL 2699) ° Authorization for Direct Deposit (form JPL 2699-1)
☐ B-13	Claims for Exceptions to Cost or Pricing Data (form JPL 2703)

NOTE: Part B forms are available on the World Wide Web at:

http://acquisition.jpl.nasa.gov/

ACKNOWLEDGEMENT

(This Completed Acknowledgement Must Accompany Your Offer)

1. Offeror name: _____

2. Name and telephone number of persons authorized to conduct negotiations:

   Name: _____ Phone Number: _____

   _____ _____

4. The Offeror acknowledges that the Specimen Contract, including the Special Provisions, General Provisions, Additional General Provisions and Attachments, are acceptable in case of contract award.

   NOTE: The General Provisions and Additional General Provisions cannot be altered without NASA approval.

   ☐ Yes ☐ No (If no, attach a detailed explanation of the exceptions, including rationale.)

3. Name, address, phone number of cognizant Government Audit Agency representative:

   _____

6. a. Audit Reports. The Offeror agrees that all Government audit reports directly related to its offer(s) and contract, if any, resulting from this solicitation are authorized to be released to JPL. ☐ Yes

   b. Are you subject to A-133? ☐ Yes ☐ No If yes, the date of the most recent report is: _____. (Enclose copy of latest report, unless previously submitted to JPL.)

7. The Offeror acknowledges that the offer will be valid for 90 days after the date for receipt of offers specified on the cover page of this solicitation.

8. The Offeror acknowledges receiving the following Addenda to the RFQ/RFP:

   Addenda No(s).: _____

   NOTE: Failure to acknowledge receipt of all Addenda may result in your offer being rejected.

9. a. Preference will be given to United States (U.S.) domestic end products under the Buy American Act (BAA) for those items to be used in the U.S. and under the Balance of Payments Program (BPP) for supplies and services (including construction) to be used outside the U.S.

   b. The Offeror certifies that each end product/service to be supplied is domestic, as defined in the BAA and BPP, except for those which the Offeror has listed, with country of origin shown, on a separate attachment to this Acknowledgment and that components of unknown origin were considered by the Offeror to have been mined, produced, or manufactured outside the U.S. The Offeror also certifies whether the offeror qualifies for any special treatment as a signator to any international agreements, such as designated country status under the Trade Agreements Act.

10. Can you supply the requested items through a Federal Supply Schedule (GSA) Contract?

☐ Yes ☐ No If yes, list FSS (GSA) Contract No. _____

11. The Offeror certifies that it is the type of business indicated below. Please check the appropriate box[es]), and fill in the blank if appropriate.

☐ Large Business
☐ Small Business (as defined by FAR)
☐ Nonprofit Organization
☐ Small Disadvantaged Business (as defined by FAR)
☐ Women-Owned Business (as defined by FAR)
☐ Labor Surplus Area Concern (as defined by FAR)
☐ Educational Institution (as defined by FAR
☐ HBCU/OMI
☐ Sole Ownership
☐ Partnership
☐ Nonprofit Organization
☐ Corporation, incorporated under the laws of the state of _____

12. Your submittal of a proposal/quotation certifies your compliance with the requirements specified in form JPL 2892, "Certifications of Nonsegregated Facilities, Clean Air and Water, Anti-Kickback Compliance, Americans with Disabilities Act Compliance, Certification and Disclosure Regarding Payments to Influence Certain Federal Transactions, and Certification of Full Disclosure Regarding Debarred, Suspended, or Proposed for Debarment Status," attached as Exhibit A to the General Provisions.

OFFEROR CERTIFICATION

The undersigned certifies that he/she is authorized to certify and to commit his/her company regarding the information on this form and for the total offer amount submitted in response to this solicitation.

Date _____ Firm _____
(name of contracting entity, not just operating division)

Name _____

Title _____

Signature _____

Telephone No. _____

GOVERNMENT PROPERTY

A. INSTRUCTIONS

1. Complete the Government Property Questionnaire (section B. of this form).

2. Include as an enclosure with your proposal the original and one copy of the cognizant Contracting Officer's consent letter, with copies of the Facilities or Equipment exhibit (referenced in paragraph B.1.b.(2), below).

B. GOVERNMENT PROPERTY QUESTIONNAIRE:

1. Government Property:

a. Will existing Government property be used in performing JPL-proposed work?

☐ Yes ☐ No

b. If "Yes:"

(1) In accordance with FAR 45.5, request from the cognizant Contracting Officer a consent letter to use Government property on a rent-free, noninterference use basis.

(2) Prepare a Facilities or Equipment exhibit stating the name, address and telephone number of the cognizant Contracting Officer, facilities contract number, location where work will be performed, purpose for which facilities or equipment will be used and projected period of intended use (first, last and intervening months). Identify the facilities or equipment by item, quantity, and Government property number. Estimate the facilities or equipment rental by monthly rate or total amount which would otherwise be an additional cost item, computed in accordance with FAR 45.403.

2. Government-Furnished Property:

a. Will JPL be required to supply Government-furnished property (GFP) beyond the GFP (if any) listed in the Specimen Contract?

☐ Yes ☐ No

b. If "Yes," prepare as a separate section on the above exhibit (see paragraph 1.b.(2)) a list of the required GFP. Identify the desired GFP by item, quantity, and use (e.g., expendable or nonexpendable, built into end item, returned to JPL). Indicate the additional costs required if such GFP is not available for performing JPL-proposed work.

COST ELEMENTS BREAKDOWN (SHORT FORM)

COST ELEMENTS			
DIRECT LABOR (Hours by labor category)	HOURS	RATE	AMOUNT
		$	$
		$	$
		$	$
		$	$
		$	$
		$	$
		$	$
		$	$
		$	$
		$	$
		$	$
TOTAL DIRECT LABOR			$
OVERHEAD	BASE	RATE	
			$
			$
			$
			$
			$
TOTAL OVERHEAD			$
MATERIAL COST			$
MATERIAL BURDEN			$
TOTAL MATERIAL			$
SUBCONTRACT COST			$
SUBCONTRACT BURDEN			$
TOTAL SUBCONTRACT			$
OTHER DIRECT COSTS (Travel, etc.)			$
			$
			$
			$
			$
			$
TOTAL ODC			$
SUB-TOTAL COST			$
TOTAL GENERAL & ADMINISTRATIVE			
TOTAL COST			$
PROFIT/FEE		%	$
TOTAL PRICE			$

COST-PLUS-A-FIXED-FEE RESEARCH & DEVELOPMENT CONTRACT

NO. TBD

BETWEEN

CALIFORNIA INSTITUTE OF TECHNOLOGY
JET PROPULSION LABORATORY
(The "Institute" or "JPL")
4800 OAK GROVE DRIVE
PASADENA, CALIFORNIA 91109-8099

AND

SPECIMEN CONTRACT

THIS CONTRACT FOR

LIGHTSAR TECHNOLOGY DEVELOPMENT FOR [TRANSMIT/RECEIVE MODULES] [PLANAR ARRAY DEPLOYMENT/SUPPORT STRUCTURES] [LIGHTWEIGHT PHASED ARRAY ANTENNA DESIGN, DEVELOPMENT, AND TEST] [L-BAND ANTENNA TECHNOLOGIES STUDY(S)]

IS A

SUBCONTRACT UNDER JPL's NASA PRIME CONTRACT

TASK ORDER NO. RF-

ESTIMATED COST:	$
FIXED FEE:	$
TOTAL:	$
TOTAL AMOUNT ALLOTTED:	$

A DO - C9 Rating is assigned to this Contract under DMS Regulation 1
Specimen Contract dated 3/24/98 to RFP L04-1-2629-975

CONTENTS

NOTE:

THE *TERMS AND CONDITIONS* AS SPECIFIED IN THE SPECIMEN CONTRACT TABLE OF CONTENTS and *GROUP B Proposal Instructions* ARE AVAILABLE ON THE WORLD WIDE WEB AT THE FOLLOWING ADDRESS:

JPL Acquisition Home Page: http://acquisition.jpl.nasa.gov/

PREAMBLE

This Contract, entered into on

by and between the CALIFORNIA INSTITUTE OF TECHNOLOGY, (hereinafter called the "Institute or "JPL), a corporation organized and existing under the laws of the State of California, and (hereinafter called the "Contractor"), a corporation organized and existing under the laws of the State of ,

and constituting a subcontract under the NASA Prime Contract between the Institute and the Government;

WITNESSETH THAT:

The Contractor agrees to furnish and deliver the supplies and perform the services set forth in this Contract for the consideration stated herein.

ARTICLE 1. STATEMENT OF WORK

SCHEDULE

(a) The Contractor shall provide the capabilities, services, materials , personnel required to perform the efforts described below for the LightSAR Project. The Contractor shall:

(1) Define technologies appropriate for a low-mass, energy efficient, low volume, high-performance imaging radar in **one of the following areas**:

(a) Efficient, lightweight, transmit/receive (T/R) modules for an L-Band phased array
(b) Lightweight, robust, planar array deployment/support structures
(c) Lightweight, phased array antenna design, development and test
(d) Any other suitable technologies which can reduce the mass and cost and/or enhance the performance of the LightSAR payload

These areas will henceforth be referred to as "elements" of the LightSAR radar instrument. Specimen requirements for overall system performance are included in the attached requirements exhibit. Other requirements may be defined later by NASA/JPL.

(2) Interact with other members of the LightSAR Payload Technology Alliance by attending meetings at intervals of six weeks at JPL.

(3) In accordance with Article 2, Delivery or Performance Schedule, report the results of the activity in written form and orally at the initial, interim and final reviews and provide the following interim and final deliverables:

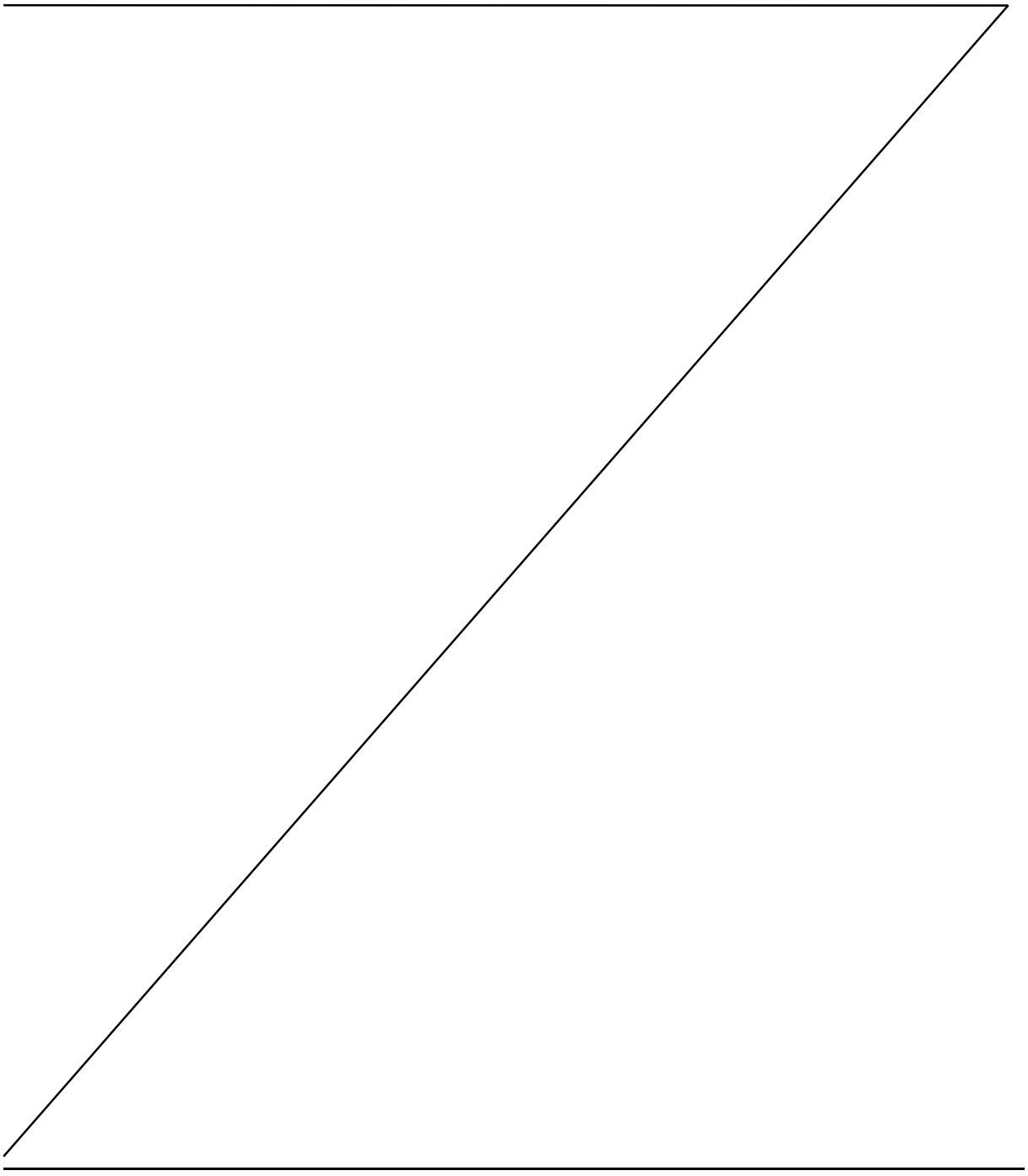
i) Detailed technology development plan;
ii) Equipment specification;
iii) Design drawings/schematics, parts lists, process procedure;
iv) Test plan and procedures;
v) Test article (breadboard and prototype), if available;
vi) Design verification report, including functional/mechanical/electrical/ environmental test results versus specifications, if available; and
vii) Monthly letter status report.

(4) Provide detailed cost and schedule profiles for follow-on phases, including flight units, at the interim review in order to support the NASA Budgetary Planning process.

(b) JPL will:
(1) Provide requirements for the LightSAR mission, as defined by NASA.
(2) Provide updates on the technology developed at JPL in support of the LightSAR Payload Technology Alliance
(3) Coordinate the activities of the LightSAR Payload Technology Alliance

(c) The following attachments are provided for information purposes:

Attachment A: LightSAR Referenced Mission
Attachment B: Transmit/Receive Modules
Attachment C: Antenna Support/Deployment Structure
Attachment D: Lightweight Phased Array Antenna

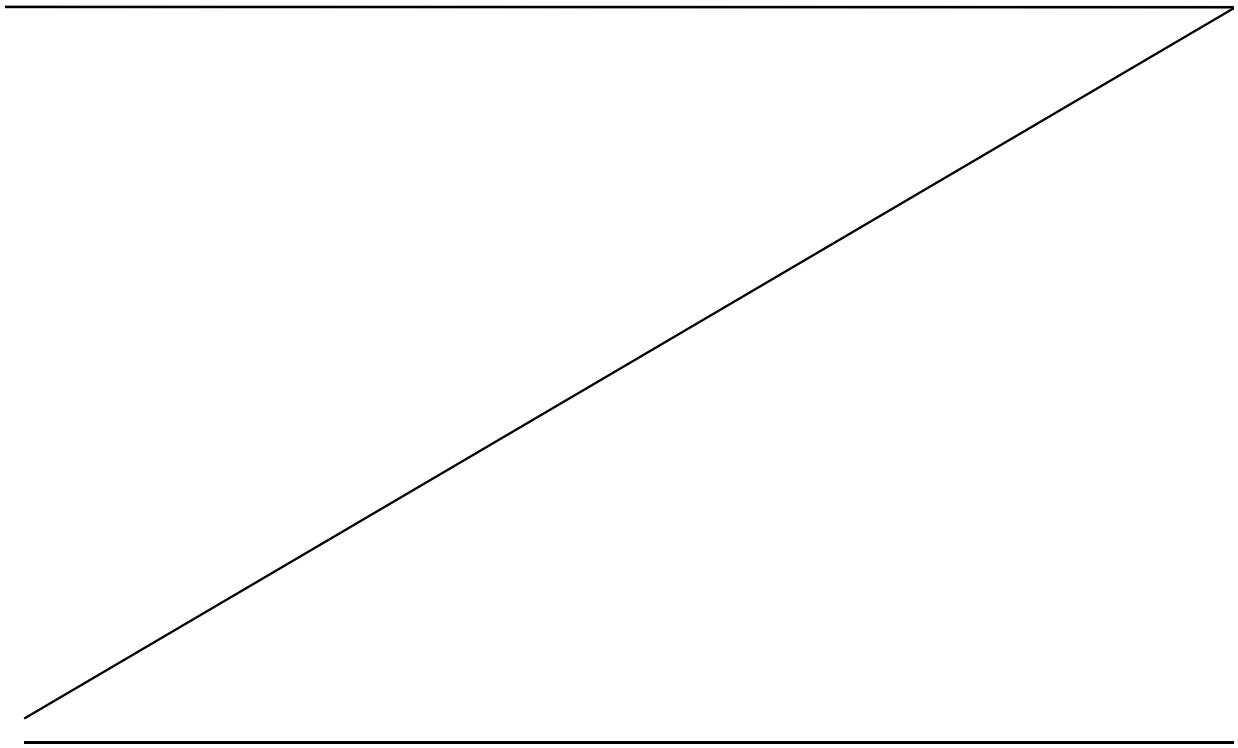


ARTICLE 2. DELIVERY OR PERFORMANCE SCHEDULE

(a) Except as otherwise provided in this Contract, the point of inspection, acceptance and delivery of all supplies deliverable under this Contract, shall be the Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, California 91109. All such supplies shall be packaged, packed, boxed, or crated in such a manner as to insure safe delivery and shall be shipped prepaid at the Contractor's expense to JPL.

(b) The Contractor shall furnish and deliver the supplies and perform the services required by ARTICLE 1, STATEMENT OF WORK, in accordance with the following schedule:

Item		On or Before
(1)	Initial Report in accordance with paragraph (a)(3)	Not later than June 24, 1998
(2)	Interim Design Phase Study Report, in accordance with paragraph (a)(3)	Not later than August 5, 1998
(3)	Final Report, including all deliverables in accordance with paragraph (a)(3)	Six Months After Contract Award
(4)	Monthly Status Report in accordance with paragraph (a)(3)	15 days after end of reporting period
(5)	Proposal for Design Validation in accordance with the Option Provision	Six Months After Contract Award



ARTICLE 3. ALLOWABLE COSTS, FIXED FEE AND PAYMENT

(a) Estimated Cost and Fixed Fee.

Estimated Cost:
Fixed Fee:
Total:

Subject to any equitable adjustment which is otherwise provided for under the provisions of this Contract, the fixed fee stated above shall remain constant for the performance of the work under this Contract. There shall be no adjustment in the amount of fixed fee or any claim for increased fixed fee because of errors or omissions made in computing the estimated cost or the fact that the actual cost varies from the estimated cost.

The total amount allotted to this Contract is $

(b) Precontract Costs. There shall be no allowance for costs incurred prior to the date of this Contract. If this Definitive Contract has been preceded by a Letter Contract, the phrase "date of this Contract" as used in this paragraph (b) shall mean the effective date of the Letter Contract.

(c) Payment of Fixed Fee. The fixed fee payable under this Contract shall be paid to the Contractor in monthly installments based upon the percentage of work completed as estimated by the Contractor and approved by JPL; subject, however, to the provisions of the "Allowable Cost and Payment" Article of this Contract.

(d) Invoices. Invoices shall be submitted, in triplicate, to JPL Accounts Payable, Mail Stop 171-372, 4800 Oak Grove Drive, Pasadena, California 91109.

(e) Allowable Costs. For the purpose of determining the amounts payable to the Contractor under this Contract, the allowability of costs shall be determined in accordance with the "Allowable Cost and Payment" Article of this Contract; provided, however, that in determining the allowability of costs, the advance understandings, if any, on particular items of cost set forth below shall be given effect. In the event of any inconsistency between such advance understandings and the cost principles referred to in the "Allowable Cost and Payment" Article referenced above, the cost principles shall prevail.

(1) Direct Costs.

(2) Indirect Costs (Overhead).

(A) Overhead rates shall be established pursuant to the General Provision of this Contract entitled "Allowable Cost and Payment

(f) The Contractor shall comply with OMB Circular A-133 for obtaining audits (only applicable to Educational Institutions).

ARTICLE 4. OPTION PROVISION

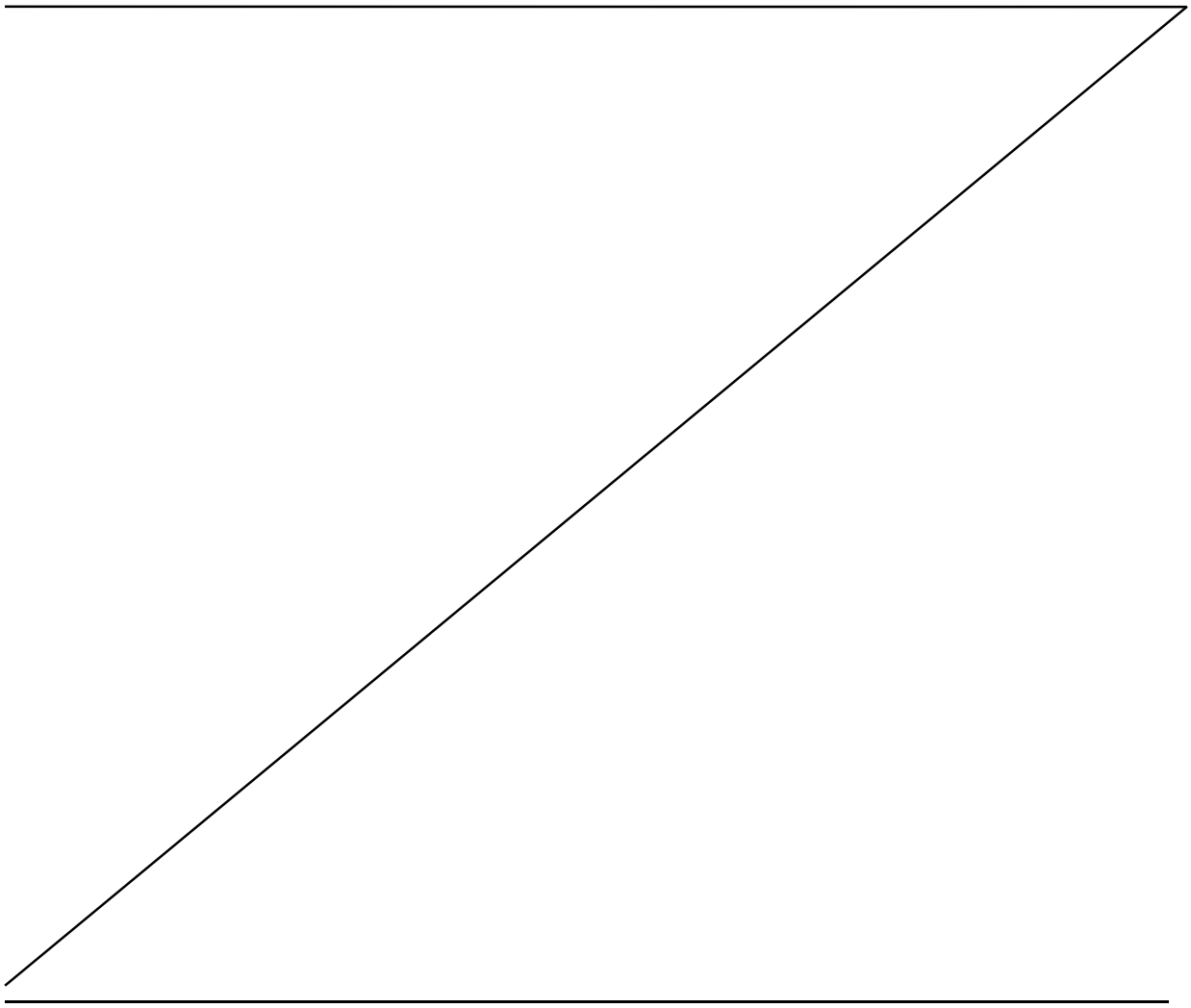
(a) Unpriced Option for Design Validation Phase

The contractor shall provide a proposal for a six to twelve month design validation phase based on the preliminary design developed during the basic contract's period of performance.

Note: The selection criteria for proceeding into this phase will be based on, but not limited to, the technical capability of the system based on the technology developmental efforts undertaken during the design study and the technical viability of that technology and applicability to the LightSAR Mission requirements. This includes the applicability of the system design to meet the minimum five year on-orbit operational requirements of the LightSAR mission; maturity and proposed estimated total cost of the system (including cost profiles); and the availability of the contractor's internal resources to meet the launch schedule requirement.

(b) Unpriced Option for the Development, Manufacture and Test Phase

The contractor shall provide a proposal for the development, manufacture and test of the flight system to be designed during the design validation phase.



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JPL Acquisition Home Page: http://acquisition.jpl.nasa.gov/

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IN WITNESS WHEREOF, the parties hereto have executed this Contract as of the day and year first above written.

CALIFORNIA INSTITUTE OF TECHNOLOGY

By_____

_____

SPECIMEN CONTRACT

By_____

_____
(Typed Name)

_____
(Title)

Instructions to Contractor: Do not insert date on Preamble page.

JPL D-13946

ATTACHMENT A
TO: RFP L04-1-2629-975

LightSAR
Reference Mission

March 1998

Jet Propulsion Laboratory
California Institute of Technology

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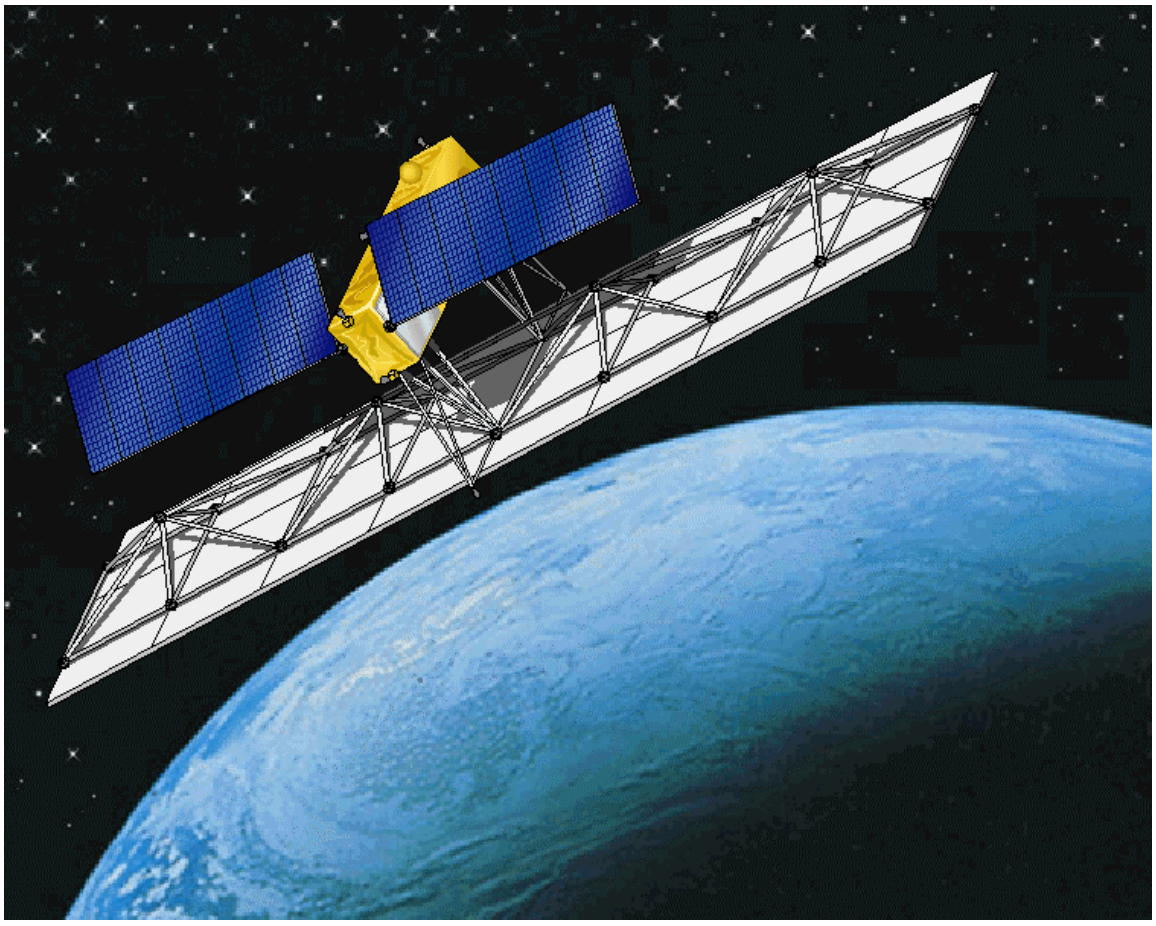
List of Tables

List of Figures

LightSAR Flight System Concept



Artist's Rendering

I. SCOPE

This document describes the essential technical characteristics of a LightSAR mission. The user framework and core payload defined in this document respond to the identified LightSAR science requirements and to an assumed minimum set of LightSAR commercial requirements. The core payload is a single frequency, L-band, 3-meter resolution, synthetic aperture radar (SAR), very similar to what was called the LightSAR Point Design in 1996. Actual commercial requirements and the resulting final payload definition for LightSAR will not be known until an industry partner for LightSAR is selected.

As with previous LightSAR mission description information, a version of this document will appear on the LightSAR web page, http://southport.jpl.nasa.gov/lightsar/.

II. LIGHTSAR OVERVIEW

A. Concept

LightSAR is a NASA initiative to develop a low cost, Earth-imaging radar satellite system that uses advanced technologies and generates valuable data for both scientific and commercial applications.

The LightSAR Reference Mission described herein is the latest update of the LightSAR Point Design, which was presented at the LightSAR Workshop at the EROS Data Center, Sioux Falls, South Dakota, on 27-29 August 1996, and documented in JPL document D-13926, "LightSAR Point Design Facts," dated 30 September 1996.

A slightly updated Point Design fact sheet was provided to the four industry study teams who performed "LightSAR System Design and Business Development Study" work for JPL in 1997. In general, these studies validated a commercial interest in LightSAR and suggested that the LightSAR payload would be enhanced with higher resolution imaging and a second operating frequency.

B. Programmatics

It is NASA's hope to engage U.S. industry in a partnering arrangement to develop and operate LightSAR.

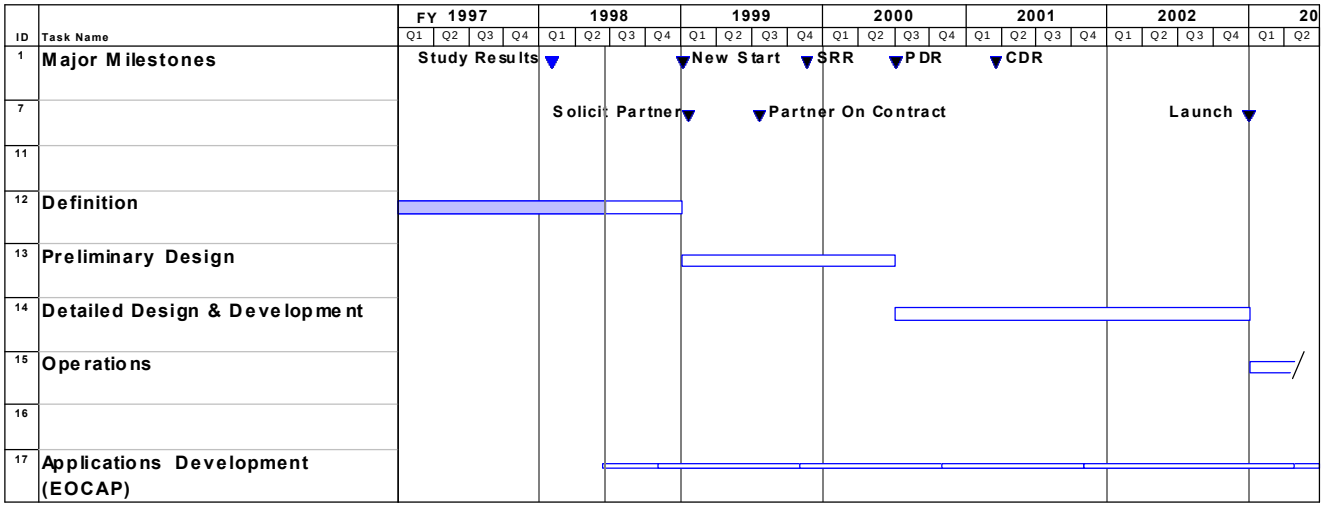
As currently envisioned, NASA's Jet Propulsion Laboratory (JPL) would manage the LightSAR program and lead the L-band radar development. The industry partner would furnish the remaining LightSAR flight and ground system elements and mission operations activities, and provide any additional payload capability that may be required by commercial users. NASA and industry would share the technical and financial risks.

Key Project Milestones

Project Start	01 Oct 98
Partnership Solicitation Released	15 Oct 98
Partner Selection/On-Contract	31 Mar 99
Launch	30 Sept 02

The project schedule of Table 1 depicts key project milestones and activities.

Table 1. Strawman Project Schedule



III. OBJECTIVES

A. Science Objectives

The LightSAR science objectives are to deliver exciting Earth science data and produce scientific information products that fulfill a fundamental part of NASA's Earth Science Enterprise strategic plan. (See JPL D-13945, LightSAR Science Requirements and Mission Enhancements, March 1998.) These objectives include:

* Monitor natural hazards (earthquakes, volcanoes, floods, etc.)
* Measure glacier/ice sheet mass balance and sea level
* Monitor carbon cycle
* Monitor soil and snow hydrology
* Monitor the role of oceans in climate change

B. Commercial Objectives

LightSAR is a commercial pathfinder mission that will lead the next level of expansion in commercial remote sensing. These objectives include:

* Produce valuable data for a diverse portfolio of commercial applications.
* Enable U.S. industry to open new markets and create long-term businesses that become sustained providers of valuable science and commercial remote sensing data.
* Other objectives: As determined by industry partner (Industry has the option to add enhanced capability, such as a higher resolution radar, as an additional payload).

IV. MISSION DESCRIPTION

A. Mission Concept

Launch: on or about September 30, 2002, by a Taurus XL/Athena-II class vehicle
Orbit: 600 km; 97.8° inclination; sun synchronous, 6 am ascending node
(97.6 min. period; 23 min. maximum eclipse)
Orbit control/maintenance requirements: capability to repeat orbit path to within a 250 m tube
Imaging access: ability to point to any Earth location every 24 hours (right and left looking)
Mission lifetime: 5 years continuous operations, including a 90-day checkout period

B. L-band Science Mission Characteristics

Global visibility
Exact orbit repeat in 8-10 days
Polarimetric measurement mode
Repeat-pass interferometric measurement mode, with precise orbit control, and rapid and accurate orbit knowledge for pointing reconstruction
Orbit control: within a 250 m tube
Orbit knowledge: < 10 cm (available within three days)
< 100 m (available within 6 hours of acquisition).
Data Calibration Requirements: Table 2. These values are derived from the accuracies needed by science and commercial retrieval algorithms and calibration techniques.
Resolution:
Dual -pol - 25m
Quad -pol - 25m
Interferometry - 25m
ScanSAR - 100m
Data processing levels: Table 3. These values are standard data products, from level 0 raw data to level 4 processed data.

Table 2. Data Calibration Requirements

	Spotlight	High Resolution Strip	Quad-Pol	Dual-Pol	Interferometric	ScanSAR
Absolute (dB):	1	1	1	1	1	1
Long-term Relative (dB):	1.5	1.5	1.5	1.5	1.5	1.5
Short-term Relative (dB):	1	1	1	1	1	1
Channel-to-channel Amplitude (dB)	N/A	N/A	0.5	0.5	N/A	0.5
Channel-to-channel Phase (□)	N/A	N/A	10	10	N/A	10
Interferometric Phase Stability	N/A	N/A	N/A	N/A	10	N/A
Cross-talk (dB)	N/A	N/A	-25	-25	N/A	-25

Table 3. Data Level Definitions

Level	Definition
Level 0	Reconstructed digital video data.
Level 0.5	Level 0 data on low density computer compatible media; e.g., Exabyte tape.
Level 1A	Reversibly processed image data (one-look, complex), full resolution, time referenced, and annotated with ancillary information; e.g., calibration coefficients and geolocation information.
Level 1B	Level 1A data that has been radiometrically corrected and geometrically resampled; e.g., a SAR image of radar backscatter or an interferogram.
Level 2	Derived geophysical parameters transformed to a uniform map projection or other space-time grid. For example, ice motion vectors, ice thickness, vegetation index.
Level 3	Level 2 data mapped on uniform space-time grids; e.g., multi-pass mosaics.
Level 4	Numerical model fields derived from Level 1B-Level 3 data, not exclusively using SAR data.

C. L-band Commercial Mission Characteristics

High-resolution modes:
Resolution □ 3 m for 15 x 20 km image spotlight products
Resolution < 10 m for 22 km stripmap products
Rapid data-take re-tasking
Site revisits at < 2 day intervals
Global visibility
Data processing levels: (per Table 3)

D. Data Collection Strategies

1. Science Data:

Data collection schedule - 7.5 minutes of L-band SAR data taking per orbit
6 min./orbit @ 105 Mbps in interferometric mode
1.5 min./orbit @ 120 Mbps in Quad-pol mode; or
1.5 min./orbit @ 60 Mbps average in Dual-pol and Scan-SAR modes
Data latency - Downlink all data taken within 270 min. (within next ~3 orbits)
Data return - Minimize data loss due to transmission

2. Commercial Data:

Minimum of 3 minutes of commercial data collection per orbit
Data latency - Downlink all data taken within 270 min. (within next ~3 orbits)
Data return - Minimize data loss due to transmission

V. FLIGHT SEGMENT

A. L-band SAR Design Characteristics

Operating frequency:
L-band @ 1217.5 - 1297.5 Mhz

Operating Baselines:
Moderate-resolution (25m) L-band SAR for Interferometry
Low-resolution (100m) L-band SAR for Scan-SAR
Multiple polarization settings: HH, HV, VH, VV

Electrical Power:
Peak rf power: 8 kW
Maximum dc power: 600W
Keep alive power: 100 W dc (est.) for Radar

Mechanical:
Total mass: 250 kg (~225 kg antenna, ~25 kg electronics)
Antenna Deployables: Two 4-panel, fan-folded stacks (reference array design)
Antenna Articulation: None, electronically steerable
Physical dimensions:
Stowed SAR antenna: two panel stacks, 1.35m x 2.9m x ~15 cm each
Deployed SAR antenna: 2.9m (El) x 10.8m (Az)
Electronics: ~10x16x30 cm (may be housed in Spacecraft bus)

Thermal:
Passive control assumed

Timing signals:
Provided internally in radar system synthesizer module

Engineering (radar health/welfare) telemetry:
100 kbps (est)

Data acquisition/storage requirements:
Simultaneous Record/Playback
90 Gbits minimum usable memory (after deduction for formatting and margin)

Operating modes: (one of the following modes at a time)
High Resolution Spotlight
High Resolution StripMap
Quad-polarization
Dual-polarization
Repeat-pass interferometry, single polarization
ScanSAR
(Standby)

These operating modes are depicted in Figure 1 and described in Table 4.

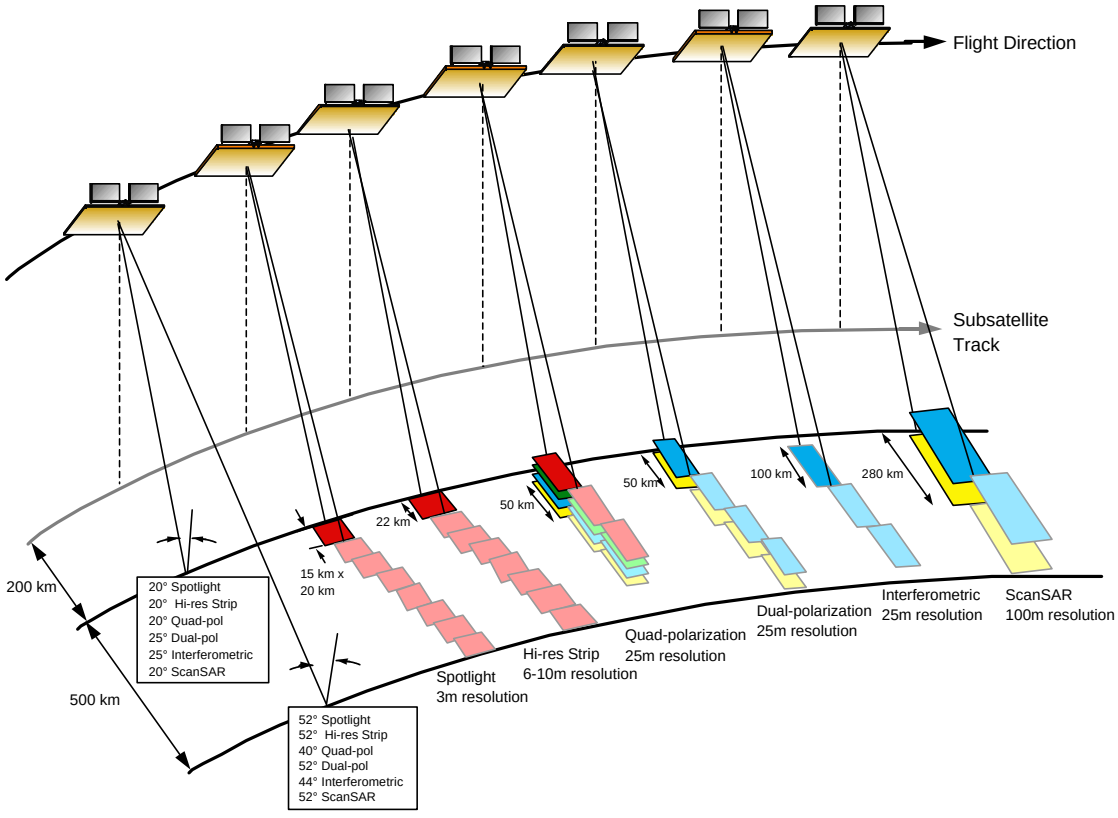


Figure 1. LightSAR Radar Modes

Table 4. L-band SAR Operating Modes/Characteristics

Mode of Operation	High Resolution Spotlight	High Resolution StripMap	Quad Polarization	Dual Polarization	Repeat Pass Interferometer	ScanSAR
Resolution (m)	3	6-10	25	25	25	100
Ground Swath (km)	15x20	22	50	50	100	280
Number of Looks	3	3	2	4	4	8
Field of View from Nadir	20-52□	20-52□	20-40□	25-52□	25-44□	20-52□
Polarizations	HH or VV	HH or VV	HH, HV, VV, VH	HH + HV, or VV + VH	HH or VV	HH + HV, or VV + VH
Noise Equiv □$_0$ (dB)	-20	-20	-30	-30	-30	-25
Bandwidth (MHz)	80	80	10, 15	10, 15	15	2.5
Data Rate (Mbps)	150	150	120	80	60	40

B. Spacecraft (Reference Mission) Design Characteristics

Pointing:
Knowledge: 0.01°.
Control: Az = 0.1°, El = 0.5°.
Stability: TBD requirement for Spotlight mode

Slew rate: Maximum 70° roll in ~10 min., including settling (for right and left looking)

Thermal: Active/passive control

Navigation:
Orbit Determination: via GPS receiver with ground-based post-processing
Knowledge (Real-time): 100m radial, crosstrack and alongtrack
Knowledge (Non-Real-time): < 10 cm radial and crosstrack; 1m alongtrack

Telecommunications:
Downlink:
Realtime and Playback telemetry data simultaneously
Peak data rate: 2x150 Mbps @ X-band; 200 kbps @ S-band
Average data rate: Up to four 5-min. passes per orbit for X-band;
One 5-min. pass/day for S-band
Uplink:
Peak command rate: 200 kbps @ S-band
Average command duration: One 5-min. pass/day for S-band

Keep Alive Power: 300 W dc (estimated)

VI. GROUND SEGMENT

In this reference mission concept the ground segment is primarily the responsibility of the LightSAR industry partner, working with NASA under an agreement in which the LightSAR industry partner:

- Contributes resources and operates the satellite, in return for ultimate effective ownership of the satellite and its data; and

- Reserves a specified portion of LightSAR operations for NASA science use free-of-charge.

Alternate arrangements will also be considered; for example, the LightSAR industry partner may, in return for a larger up-front investment, wish to charge NASA for data.

The LightSAR industry partner is presumed to be a business enterprise or consortium of companies that have organized themselves to sell Earth-imaging radar products and services for profit. It is further assumed that the LightSAR industry partner is granted:

- a 15CFR960 remote sensing operating license by the Department of Commerce, and

- a license for the LightSAR radar operating frequency band by the NTIA.

A. Functional Elements

The ground segment design connects the end-users to the radar satellite. The functional elements may be implemented in various ways at widely dispersed locations. Actual design implementation will be tailored to the needs of the LightSAR industry partner. Figure 2 shows a simplified conceptual ground segment.

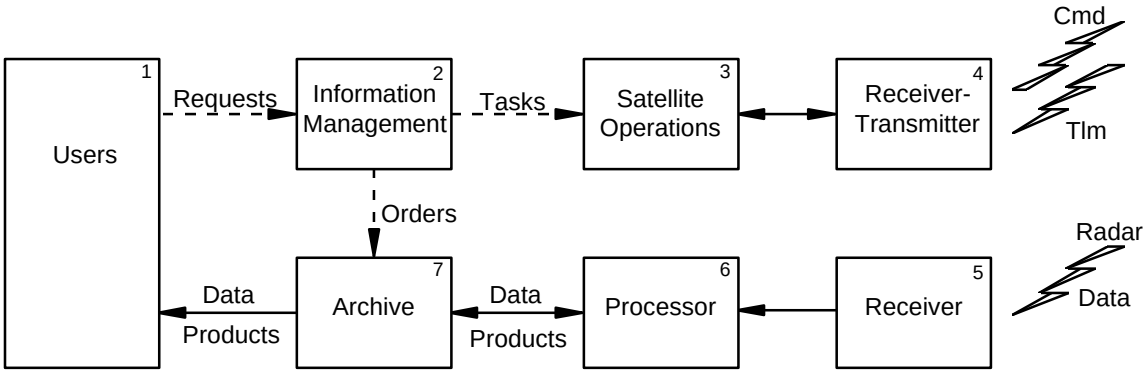


Figure 2. Simplified LightSAR Ground Segment Concept

The Users represents LightSAR customers, who request products and services, act as data product consumers, and consist of commercial, governmental, and value-added users of LightSAR data.

The Information Management provides customer services (e.g., sales of data product, software, etc.) and controls radar data flow. It performs data product acquisition planning and prioritization, tasks satellite operations for data acquisition, orders data product from the data archive, manages data product inventory, and manages interfaces with other information and data service centers.

The Satellite Operations monitors and controls satellite performance in flight, performs radar data acquisition planning, command generation, ground station scheduling, telemetry processing, orbit determination, navigation, station keeping, and resource management.

The Telemetry and Command Receiver-Transmitter Ground Station provides the S-band uplink of commands to the satellite and downlink of engineering telemetry transmitted from/to the Satellite Operations element.

The Radar Data Receiver Ground Station provides radar data telemetry reception and transport. The X-band downlink data stream is frame synchronized, decoded, either packetized or retransmitted or stored on high-density media for later transport. The ground station reports readiness status to the Satellite Operations element.

The Processor provides processing of incoming and archived radar data to the required level (Table 3), and data product (Table 5) delivery to the archive. It also performs data calibration processing (Table 2) and distributes raw calibration data, as tasked. These services may also be performed by users and/or be collocated with other functions.

The Archive provides storage and retrieval of data product inventory, and provides media transcription, data product delivery to users, and the necessary data handling and transport, as ordered by the information management element, and in coordination with other information and data service centers. These services may be collocated with other functions. Planned archive storage lifetime is 10 years.

Table 5. Data Product Design

	Spotlight	High Resolution Strip	Quad-Pol	Dual-Pol	Interferometric	ScanSAR
Pixel Spacing (m)	2	4	12.5	12.5	N/A	12.5
Location Accuracy(m)	3	6	100	100	N/A	500
ISLR (dB)	-13	-13	-13	-13	-13	-13
Distortion (%)	0.20	0.20	0.20	0.20	0.20	0.20

B. Data/Tasking

The division of responsibilities between the commercial based LightSAR industry partner and the NASA constituency for the reference mission is summarized as follows:

1. Commercial

Spacecraft and Payload Command & Control
Commercial payload calibration
Commercial payload performance monitoring
Commercial payload SAR processing
NASA payload Level 0 processing
Commercial data archive
Commercial data management/marketing/sales
Commercial SAR processor development
NASA SAR processor development
Commercial/NASA data acquisition
NASA payload Level 1 processing

2. NASA/JPL Constituency

NASA payload calibration
NASA payload performance monitoring
NASA Level 0 data archiving
NASA Level 0 data management
NASA Level 0 data distribution
NASA Level 1 data archiving
NASA Level 1 data management
NASA Level 1 data distribution
Precision Orbit Determination
NASA Level 1 processing
NASA Level 2 processing

ATTACHMENT B
Transmit/Receive Modules

Introduction: LightSAR will use an active phased array antenna operating at L-band. As such it will require transmit/receive (TR) modules to drive the antenna's radiating elements and to amplify the received signal. Many of the characteristics of the T/R modules expected for LightSAR should be similar to those of T/R modules used in previous spaceborne radars, including SIR-C. However, advances in solid-state microwave technology (e.g., the development of MMICs) should make it possible to make modules that are both smaller and more capable than those used on previous missions. In this exhibit a set of T/R module specifications for LightSAR are presented; these should be treated as desired specifications rather than hard requirements. Also discussed are some potential tradeoffs in the design and development of suitable T/R modules. Prospective contractors interested in participating in LightSAR T/R module technology development should indicate in their response how their technology can help meet the desired specifications and should discuss their approach to the design, development, and manufacturing processes, although this first phase of work addresses only design.

LightSAR T/R Module Specifications: Each T/R module will accept an L-band chirp from the RF electronics via the antenna feed manifold. It will apply a phase shift specified by four bits, will amplify to high power, and will output the high power signal to either the H pol or V pol antenna feed, as commanded. During receive, it must accept signals from both antenna polarizations simultaneously, amplify the signals, and send them to the H and V channels of the receiver via the feed manifold. Each module must allow commanding of the polarization, commanding of switches for transmit/receive, and commanding of the phase shift. Furthermore, it must have an enable/disable option to allow a module to be turned off. The DC voltages used by the modules are to be derived from the nominal 28 VDC spacecraft voltage.

Because the T/R modules are planned to be an integral part of the antenna array structure, they must be compatible with a laminated antenna array panel layout. Consideration must be given to both their mechanical interfacing to the panel and to their thermal control. The modules must also be compatible with the antenna manufacturing process. The T/R modules must be able to withstand both the launch and on-orbit environmental characteristics. The attached table summarizes the desired specifications for the T/R modules, assuming the preliminary LightSAR design. The DC voltage and current and the thermal and environmental characteristics are To Be Determined (TBD). We expect the environmental specifications to be similar to those for other spaceborne missions operating at the LightSAR altitude. The attached figure shows one possible architecture for the LightSAR T/R modules. This is meant only as an example; other architectures which can provide the required functional and performance capabilities are welcome.

Potential Tradeoffs: In designing the LightSAR T/R modules it is expected that a number of tradeoffs will need to be studied and that these might result in changes to the specifications. One possible tradeoff would be use of single polarization modules. While this will double the required number of modules, the modules themselves would be simpler and lighter. Another tradeoff is in the area of power distribution. Placing a power supply within each T/R module would simplify panel design and assembly but would increase module mass. A third tradeoff would involve reducing cost by making use of existing chips or components. This cost reduction might result in additional mass or reduced functionality, as compared with a custom design. Analyses of such tradeoffs will be required before embarking on a T/R module development program.

Preliminary T/R Module Specifications

A. Electrical Performance

Transmitter:	
peak power	30 W (45 dBm)
pulse width	< 20 μs
PRF	< 2800 Hz
duty cycle	< 5%
gain	30 dB
efficiency	> 40%
polarization switching time	< 10 μs
Receiver:	
noise figure	<1.5 dB
gain	30 dB
Pout (1 dB compress.)	-10 dBm
Pout (3rd order)	0 dBm
recovery time (Pin=-10 dBm)	< 1 μs
Phase-Shifter:	
phase steps (4 bit res.)	22.5, 45, 90, & 180 degrees
switching speed	< 10 μs
max scan angle	< +/- 20 degrees
Overall:	
frequency	1217.5 - 1297.5 MHz
bandwidth	80 MHz
input/output impedance	50 Ohms
T/R isolation	< -70 dB
T/R switching time	< 10 μs
cross-pol isolation	< -30 dB
stability	unconditional
gain variation (unit-unit tracking)	+/- 0.6 dB
phase variation (unit-unit tracking)	+/- 6 degrees
gain flatness	+/- 0.25 dB
phase linearity	+/- 4 degrees
VSWR over 80 MHz BW	< 1.5:1
Control/Timing/Telemetry Interface:	
input	serial commands
output	serial telemetry

DC Power Interface:

supply voltage	TBD
current	TBD

B. Mechanical Characteristics

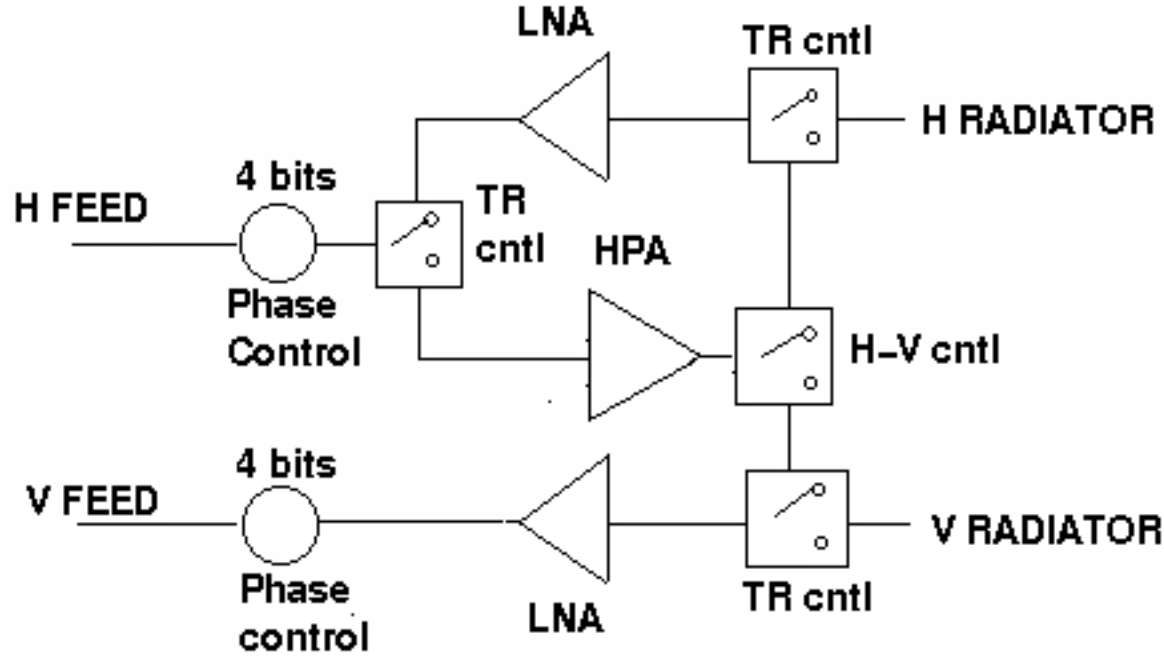
Mass	< 50 g
Height	< 1.3 cm

C. Thermal Characteristics

TBD

D. Environmental Characteristics

TBD



Possible architecture for dual-polarization T/R module. Control, timing and power interfaces not shown.

ATTACHMENT C
Antenna Support/Deployment Structure

Overview: The LightSAR support structure should provide the stiffest and most thermally stable antenna structure for its weight while accommodating a reliable deployment scheme. In addition to controlling/synchronizing antenna deployment, the support structure determines the initial planar precision of the panels and the variation of that precision as a function of the initial boundary conditions prior to deployment. Since it is the highest risk element of the antenna mechanical subsystem, it is absolutely essential that any panel/support structure concept considered will have been previously flight validated by an experiment, technology demonstration, or an actual application with the same stringent demands for mechanical performance as that of LightSAR's.

LightSAR Mission Overview: The design of the LightSAR mission is still under study; hence, a final antenna design has not been specified. There have been several workshops and study groups evaluating the LightSAR mission and instrument requirements, and a conceptual system design has been completed with more detailed system studies still ongoing. The current concept operates at L-band and utilizes a 10.8 m x 2.8 m array of radiating patch antennas. The baseline antenna/buss structure configuration is based on supporting the deployed antenna from the bus assembly at its geometric center so that the planar array RF elements have an unobstructed field of view. The stowed antenna configuration is achieved by folding the two antenna "wings" and then rotating them using a single articulation about the buss structure's longitudinal axis. The stacked antenna panels are constrained by the launch restraint system located at the sides of the buss structure. The proposed LightSAR orbit is polar and sun-synchronous at an altitude of 600 km and is reached using a Taurus Class launch vehicle.

LightSAR Antenna Mechanical Subsystem: The proposed antenna structural concept consists of eight ultra light weight 1.35 x 2.9 meter planar rigid panels that are hinged together in series into an aperture which is supported by a self deployable truss structure. Both the hinged panels and their support structure fold up into a very compact stowed configuration whose planar dimensions are that of one panel with a hinged panel stack height of no more than twice that of the combined panel thicknesses (without support structure). A controlled and sequenced deployment of the panels is required. Once completely deployed, the support structure should provide a flat, mechanically stiff, and thermally stable antenna configuration.

Summary:

- The highest risk element of the LightSAR Antenna mechanical subsystem is the deployable support structure that is integrated with the SAR panels, and controls antenna deployment and dimensional stability on orbit.
- The support structure functional drivers include low mass, mechanical deployment reliability, planar surface precision, orbital thermal stability, and structural stiffness.
- To mitigate risk the LightSAR Support Structure technology must have a demonstrated reliable mechanical performance that requires minimum modification to meet LightSAR design requirements.

LightSAR Antenna Deployable Support Structure
Operational Specifications

The LightSAR Deployable Support Structure (DDS) is a folding three-dimensional support structure and tripod assembly which deploys the LightSAR Synthetic Aperture Radar Antenna. The structure stows the antenna aperture (panels, electronics, wiring, etc.) into a compact, lightweight, and stable launch package. Upon deployment, the structure configures into a flat and rigid support for the SAR antenna. The DDS must meet the following SAR antenna operational and configuration specifications:

- **Instrument Characteristics**

Antenna Type	Active Phased Array
Antenna Size	2.9 meter (elev.) x 10.8 meters (az.)
Frequency	1217.5 - 1297.5 MHz
Mass	

- Total < 250 Kg
- DDS (including drive motor) < 35 Kg

- **Aperture Requirements**

Full aperture Planar Dimen. Stability	
Planar Flatness	+-0.25 in
Temperature Regime	75 to -45 deg. C
Resonant Frequency	
Deployed	> 0.5 Hz
Stowed	> 10 Hz

- **Orbital Characteristics (see Exhibit 1)**

Geometry
Altitude
Inclination
Period
Repeat Cycle
Coverage

- **Mission Characteristics (see Exhibit 1)**

Launch Vehicle
Attitude Control
Duration
Antenna Stowed Packaging Efficiency

ATTACHMENT D
Lightweight, Phased Array Antenna

Introduction: The core LightSAR payload will include an active phased array antenna operating at L-band. This antenna should be lightweight, in order to minimize launch mass and cost, with a goal of less than 6 kg/m^2 for the whole antenna, not including the deployment/support structure. The specifications for the LightSAR antenna presented in this exhibit should be treated as desired specifications rather than hard requirements. Prospective contractors interested in participating in LightSAR antenna technology development should indicate in their response how their technology can help meet the desired specifications and should discuss their approach to the design, development, and manufacturing processes, although this first phase of work addresses only design.

LightSAR L-Band Antenna Specifications: The LightSAR antenna will be 10.8 m long by 2.9 meters wide, and should stow in launch configuration in two stacks each of dimension 1.35m x 2.9m x ~15 cm. On deployment, the antenna flatness should be maintained to within 0.012 cm (one-twentieth of a wavelength) to avoid unacceptable distortions in the antenna pattern. The antenna will be a distributed phased array, with a peak power output capability of 8 kW in total. The radiating elements should be mis=crostrip patches, and a honeycomb duroid dielectric layer is recommended (for lightness). Lightweight implementations of the RF and DC feed systems will be an integral and important part of the antenna design. The antenna should have dual linear polarizations, and be capable of alternately transmitting pulses with Horizontal and Vertical polarizations, with switching times of less than 1 ms. The antenna should also be capable of receiving with Horizontal and Vertical polarizations simultaneously, and routing the received signals to different RF receive chains. Electronic steering of the antenna beam in elevation over ± 20 degrees is required, and azimuth steering over ± 4 degrees. In order to operate in ScanSAR mode, the electronic steering should be switchable, with millisecond update rates. Timing signals for antenna switching will be provided by a separate subsystem within the radar payload.

The design of the antenna array structure must be flexible enough to accomodate the T/R modules and antenna deployment structure also being developed for the LightSAR L-Band payload. Consideration must be given to both the mechanical interfacing with these elements and to their thermal control. The antenna itself must be able to withstand both the launch and on-orbit environmental characteristics. The DC voltage and current and the thermal and environmental characteristics are To Be Determined (TBD). We expect the environmental specifications to be similar to those for other spaceborne missions operating at the LightSAR altitude. The attached figure shows one possible architecture for the LightSAR antenna. This is meant only as an example; other architectures which can provide the required functional and performance capabilities are welcome.

Potential Tradeoffs: In designing the LightSAR L-Band antenna it is expected that a number of tradeoffs will need to be studied and that these might result in changes to the specifications. A significant reduction in antenna thickness, provided it also yields low mass per unit area, would be an acceptable trade-off. Lightweight implementations of the RF and DC feed systems may influence the choice of power distribution to the T/R modules.

Preliminary Antenna Specifications

A. Electrical Performance

frequency	1217.5 - 1297.5 MHz
bandwidth	80 MHz
Transmit polarizations	H and V
Receive polarizations	H and V
Polarization isolation	< -30 dB
VSWR over 80 MHz BW	< 1.5:1
Electronic scan angles	± 20 degrees in elevation
	± 4 degrees in azimuth

DC Power Interface:

supply voltage	TBD
current	TBD

B. Mechanical Characteristics

Size when deployed	10.8 x 2.9 m
Size when deployed (two stacks)	1.35 x 2.9 x .15m each
Mass (whole antenna)	< 225 kg
Flatness (over deployed array)	< 1.2 cm

C. Thermal Characteristics

TBD

D. Environmental Characteristics

TBD